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Design and Fabrication of Starting Lever Using Freewheel

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ABSTRACT

The objective of our project is to design and fabricate an innovative type of starting lever combined with freewheel or overrunning clutch. The traditional engine starter by manual energy has certain disadvantage like slipping apart once the engine starts because of high centrifugal force. Our design utilizes the benefit of freewheel (also known as overrunning clutch, one way clutch) which transmits torque when $N_1 > N_2$ but will transmit no torque when $N_1 < N_2$, where N_1 and N_2 represents the rpm of shaft 1 and shaft 2. This mechanism is utilized by us to develop a good and efficient starting lever. The conditions of a driven shaft spinning faster than its driveshaft exists in most bicycles when the rider holds his or her feet still, no longer pushing the pedals. In a fixed gear bicycle, without a free wheel, the rear wheel would drive the pedals around.

Keywords: Overrunning clutch, starting lever, driving and driven shaft.

1. INTRODUCTION

A power transmission system converts energy into useful work. In a typical system, an electric motor is used to convert electrical energy into rotating mechanical energy. Mechanical energy can be transmitted by a system of mechanical components to perform some useful or work. This system, composed of mechanical components may include one or more of the following:

- Shafts • Shaft couplings
- Bearings • Pulleys and belts
- Cams • Clutches and brakes • Levers • Etc.

Before the advent of the starter motor, engines were started by various methods including wind-up springs, gunpowder cylinders, and human-powered techniques such as a removable crank handle which engaged the front of the crankshaft, pulling on an airplane propeller, or pulling a cord that was wound around an open-face pulley

Originally, a hand-crank was used to start engines, but it was inconvenient, difficult, and dangerous to crank-start an engine. The behavior of an engine during starting is not always predictable. The engine can kick back, causing sudden reverse rotation. Many manual starters included a one-directional slip or release provision so that once engine rotation began, the starter would disengage from the engine. In the event of a kickback, the reverse rotation of the engine could suddenly engage the starter, causing the crank to unexpectedly and violently jerk, possibly injuring the operator. For cord-wound starters, a kickback could pull the operator towards the engine or machine, or swing the starter cord and handle at high speed around the starter pulley. Additionally, care had to be taken to retard the spark in order to prevent backfiring; with an advanced spark setting, the engine could kick back (run in reverse), pulling the crank with it, because the overrun safety mechanism works in one direction only.

Although users were advised to cup their fingers under the crank and pull up, it felt natural for operators to grasp the handle with the fingers on one side, the thumb on the other. Even a simple backfire could result in a broken thumb; it was possible to end up with a broken wrist, or worse. Moreover, increasingly larger engines with higher compression ratios made hand cranking a more physically demanding endeavor.

Freewheels are precision clutches which positively lock to transmit torque in one direction of rotation, but are totally released in the opposite direction, these often provide the simplest and lowest cost solutions for many applications. Combination of both this mechanical parts by welding makes our project possible. Abbreviations and Acronym

2. BENEFITS

By its nature, a freewheel mechanism acts as an automatic clutch, making it possible to change gears in a manual gearbox, either up- or downshifting, without depressing the clutch pedal, limiting the use of the manual clutch to starting from standstill or stopping. The Saab freewheel can be engaged or disengaged by the driver by pulling or pushing a lever. This will lock or unlock the main shaft with the freewheel hub.

A freewheel also produces slightly better fuel economy on carbureted engines (without fuel turn-off on engine brake) and less wear on the manual clutch, but leads to more wear on the brakes as there is no longer any ability to perform engine braking. This may make freewheel transmissions dangerous for use on trucks and automobiles driven in mountainous regions, as prolonged and continuous application of brakes to limit vehicle speed soon leads to brake-system overheating followed shortly by total failure.

3. USES

3.1 Agricultural equipment

In agricultural equipment an overrunning clutch is typically used on hay balers and other equipment with a high inertial load, particularly when used in conjunction with a tractor without a live power take-off (PTO). Without a live PTO, a high inertial load can cause the tractor to continue to move forward even when the foot clutch is depressed, creating an unsafe condition. By disconnecting the load from the PTO under these conditions, the overrunning clutch improves safety. Similarly, many unpowered 'push' cylinder lawnmowers use a freewheel to drive the blades: these are geared or chain-driven to rotate at high speed and the freewheel prevents their momentum being transferred in the reverse direction through the drive when the machine is halted.

3.2 Engine starters

A freewheel assembly is also widely used on engine starters as a kind of protective device. Starter motors usually need to spin at 3,000 RPM to get the engine to turn over. When the key is turned to the start position for any amount of time after the engine has already turned over, the starter can not spin fast enough to keep up with the flywheel. Because of the extreme gear ratio between starter gear and flywheel (about 15 or 20:1) it would spin the starter armature at dangerously high speeds, causing an explosion when the centripetal force acting on the copper coils wound in the armature can no longer resist the outward force acting on them. In starters without the freewheel or overrun clutch this would be a major problem because, with the flywheel spinning at about 1,000 RPM at idle, the starter, if engaged with the flywheel, would be forced to spin between 15,000 and 20,000 RPM. Once the engine has turned over and is running, the overrun clutch will release the starter from the flywheel and prevent the gears from re-meshing (as in an accidental turning of the ignition key) while the engine is running. A freewheel clutch is now used in many motorcycles with an electric starter motor. It is used as a replacement for the Bendix drive used on most auto starters because it reduces the electrical needs of the starting system.

3.3 Vehicle transmissions

In addition to the automotive uses listed above (i.e. in two-stroke-engine vehicles and early four-stroke Saabs), freewheels were used in some luxury or up-market conventional cars (such as Rovers and Cords) from the 1930s into the 1960s. The freewheel meant that the engine returned to its idle speed on the overrun, thus greatly reducing noise from both the engine and gearbox. The mechanism could usually be locked to provide engine braking if needed. A freewheel was also used in the original Land Rover vehicle from 1948 to 1951. The freewheel controlled drive from the gearbox to the front axle, which disengaged on the overrun. This allowed the vehicle to have a permanent 4 wheel drive system by avoiding 'wind-up' forces in the transmission. This system worked, but produced unpredictable handling, especially in slippery conditions or when towing, and was replaced by a conventional selectable 4WD system. Other car makers fitted a freewheel between engine and gearbox as a form of automatic clutch. Once the driver released the throttle and the vehicle was on the overrun the freewheel would disengage and a gear change could be made without the use of the clutch pedal. This feature appeared mainly on large, luxury cars which often had heavy clutches and gearboxes without synchromesh as the freewheel permitted a smoother and quieter change. Citroën combined a freewheel and a centrifugal clutch to make the so-called 'Traffi Clutch' where the car could be started, stopped and the lower gears be changed without using the clutch pedal. This was an option on Citroën 2CVs and its derivatives and, as the name implied, was marketed as a benefit for driving in congested urban areas. A common use of freewheeling mechanisms is in automatic transmissions. For instance traditional, hydraulic General Motors transmissions such as the Turbo-Hydramatic 400 provide freewheeling in all gears lower than the selected gear. E.g., if the gear selector on a three-speed transmission is labelled 'drive'(3)-'super'(2)-'low'(1) and the driver has selected 'super', the transmission will freewheel if first gear is engaged, but not in second or third gears; if in 'drive' it will freewheel in first or second; finally, if in low, it will not freewheel in any gear. This allows the driver to select a lower range to achieve engine braking at various speeds, for instance when descending steep hills. In the older style of bicycle, where the freewheel mechanism is included in the gear assembly, the system is called a freewheel, whereas the newer style, in which the freewheel mechanism is in the hub, is called a free hub.

4. METHODOLOGY

Initially before starting working on the project ,the size and cost was approximately determined. Then the raw material for the project was obtained through various means. Then the raw material are subjected to various processes such as drilling ,facing and turning with help of lathe. The appropriate tool was selected for various processes. Facing and turning operations are performed using lathe. The welding operations are performed to assemble the various parts of the system.

4.1 Fabrication of Main Parts

The starting lever developed for this project has following parts,

a. Freewheel with sprocket b. Handle lever

Fig:1 Sprocket with freewheel

A freewheel with sprocket of total diameter of 85mm is selected.It has an outer circle diameter of 62mm and 57mm.It has an inner circle diameter of 56mm and 35mm (larger and smaller respectively).Total number of ball bearing are 56. Handle lever: A bar of cast iron is used to make the starting lever. It is of length 46.5mm. It is made of mild steel.

4.2 Hand Lever

The diesel engine which is used as a generator requires certain starting torque to make it running. Engines were started by various methods including wind-up springs, gunpowder cylinders, and human-powered techniques such as a removable crank handle. Originally, a hand lever was used to start engines, but it was inconvenient, difficult, and dangerous to crank-start an engine. The behavior of an engine during starting is not always predictable. The engine can kick back, causing sudden reverse rotation. Many manual starters included a one-directional slip or release provision so that once engine rotation began, the starter would disengage from the engine. In the event of a kickback, the reverse rotation of the engine could suddenly engage the starter, causing the crank to unexpectedly and violently jerk, possibly injuring the operator. For cord-wound starters, a kickback could pull the operator towards the engine or machine, or swing the starter cord and handle at high speed around the starter pulley. Even though lever had an overrun mechanism, when the engine started, the crank could begin to spin along with the crankshaft and potentially strike the person cranking the engine. Additionally, care had to be taken to retard the spark in order to prevent backfiring; with an advanced spark setting, the engine could kick back (run in reverse), pulling the crank with it, because the overrun safety mechanism works in one direction only. Although users were advised to cup their fingers under the crank and pull up, it felt natural for operators to grasp the handle with the fingers on one side, the thumb on the other. Even a simple backfire could result in a broken thumb; it was possible to end up with a broken wrist, or worse. Moreover, increasingly larger engines with higher compression ratios made hand cranking a more physically demanding endeavor. Even today hand lever or hand crank are used to start diesel generator in festivals, marriage functions.

4.3 Calculation

Brake power: 3.75kw
Speed: 1500rpm
Specification of freewheel clutch:
No. of balls (Zb): 56
Coefficient of friction (μ) : 0.8
Diameter of clutch (D) : 62mm
Circumference of circle = $2\pi R$
Torque transmitted (MT) = Power in kw (P) x 9550 Speed (N) in rpm

Spring force (FS) = FT $[(\cos\alpha - \mu \sin\alpha) / (sin\alpha + \mu cos\alpha) - \mu]$

α = angle of inclination of groove,

$F_T = \frac{2M_T}{D}$

Force on each spring (F) = FS / ZB

Stiffness on spring (KS) = K1/ n

n = no. of turns in spring, k1=stiffness factor

Compression of spring (γ_1) = F / KS

Movement of ball while clutch is slipping (γ_2) = d/2$(1 - cos\alpha)$

4.4 Working

1. Fasting of threads: The thread on inner circle of new starting lever is fixed to the threads provided on the projected part from the engine.
2. Rotation of lever: The circular rotation of arms gives a starting torque to the engine, at certain speed engine starts to run at a high speed above 3000rpm.
3. Over running of lever: At this period the speed of engine is greater than the speed of the hand lever. Here the important the mechanism of our new device starts due to which the clutch automatically disengages and provides no transmission of torque in the reverse direction.
4. Locking of lever: When the engine is running, lever is of no motion, this lever can be locked by using pin lock mechanism.

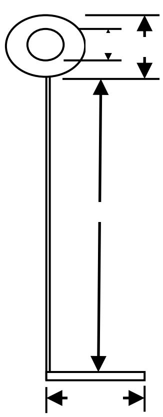

Fig: 2 Design diagram

Fig: 3 Final product

5. APPLICATION

The important application of starting lever using freewheel is for starting of an diesel engine by manual power. Older starter caused some problems like the engine can kick back, due to sudden rotation., causing the crank to unexpectedly and violently jerk, possibly injuring the operator. For cord-wound starters, a kickback could pull the operator towards the engine or machine, or swing the starter cord and handle at high speed around the starter pulley. Even a simple backfire could result in a broken thumb; it was possible to end up with a broken wrist, or worse. With our new type of hand lever this type of problem can be solved and safety could be ensured.

6. CONCLUSION

It is used for starting of a diesel engine in a good manner .The product developed by us does not cause any damage to the person starting the engine. Also the cost of the device is less and simple in construction. The calculation of diameter of ball, stiffness and torque transmitted was done.

REFERENCES

1. K .V . Bhandari (2004) ‘Machine Design’
2. Arun T.A , Kaliappan S (2015) “ Performance test of bio-diesel using jatropha and palm oil on a single cylinder diesel engine with DOE “ , International Journal of Applied Engineering Research, Vol. 10 No.33, PP- 25907- 25914.DR. V . Jayakumar (2011) ‘Design of Transmission Systems’
3. P. C. Sharma (2010) ‘Production technology’
4. M.Chandru, M.Durairaj, S.Saravanakumar, S.Kaliappan (2015) “Internal Flow Analysis Of Submersible Pump Impeller Using CFD”, International Journal of Applied Engineering Research, Vol. 10 No.33, PP- 25937- 25944.
5. S .S. Manion, P. Raja Gopal (2005) ‘Workshop Technology’
6. s. kaliappan, m. d. rajkamal and d. balamurali “Numerical analysis of centrifugal pump impellor for performance impovement ” , International Journal of Chemical Sciences (IJCS) , , Volume –14, Issue – 02, May– 2016, PP – 1148-1156 .
7. www.gme.de
8. M D Raj Kamal, S.Kaliappan, S.Socrates, G.Jagadeesh Babu ((2017) “CFD Analysis of Single Cylinder IC Engine Inlet Swirl Valve”, International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137, Volume – 02, Issue – 08, August – 2017, PP – 34-46.www.crossmorse.com
9. www.sternsclutches.com
10. S.Kaliappan, J.Lokesh, P.Mahaneesh, M.Siva, “ Mechanical Design and Analysis of AGV for Cost Reduction of Material Handling in Automobile Industries” , International research journal for automotive technology (IRJAT) Volume 01-Issue 1, January 2018, PP.1- 7.
11. www.renold.com
12. S.Kaliappan, M.D.Raj Kamal, Dr.S.Mohanamurugan, Dr. P.K.Nagarajan (2018) “Analysis of innovative connecting rod using finite element analysis ”,Taga journal of graphic technology, Vol. 14 -2018, PP-1147-1152.
13. www.stieber.de
14. T.Mothilal, M.D.Raj Kamal, S.Kaliappan, G.Jagadeesh Babu, S.Socrates (2018) “Experimental and Numerical Analysis of Wind Turbine” , international research journal of automotive technology (IRJAT) Volume 01-Issue 2, March 2018, PP.1- 8.